POSSIBLE LIFETIME OF IMPACT CRATERS ON MARTIAN EOLIAN LANDFORMS.

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Introduction. Density of impact craters on planetary surfaces is a result of two competing processes: 1) crater formation and 2) crater destruction [2, 3, 9]. In our previous works [4, 5, 8] we determined crater densities on various eolian landforms of Mars and compared them with crater densities in the adjacent areas with no or rare obvious eolian landforms. Using the determined crater statistics and the calibration curve of [6, 7] we determined absolute model surface ages (see table) of the studied areas assuming that the studied crater populations were the production ones that implied strong predominance of crater formation over the crater destruction [2, 3, 9]. Typically crater densities on the eolian landforms are significantly lower than in the adjacent areas indicating a noticeably lower age for the eolian landforms. The size-frequency distribution of smaller sized craters even with diameters of hundreds of meters deviates often from the standard calibration curve with the typical "production" slope. This leads to the second possible end-member option for smaller craters: crater populations in the studied areas are the steady-state ones. This means that an equilibrium between crater formation and crater destruction has been reached. This option seems to be unreal for the areas with no or rare eolian landforms but quite real for the areas with abundant eolian landforms. Goal of this work is to consider the second option for the studied areas of Mars making theoretical model of this case and comparing the model with observations.

Model. Following [2] general expression for changing of crater amount in the considered area per time interval (**dN/dt**) can be written as:

$$\mathbf{dN/dt = dN_{form}/dt + dN_{destr}/dt.}$$

Let us assume that the cratering rate is constant in time:

$$\mathbf{dN_{form}/dt = q = const,}$$

and that at any given moment the rate of crater destruction is proportional to total amount of craters in the area at that moment:

$$\mathbf{dN_{destr}/dt \sim N.}$$

If λ is probability of destruction of one crater per time unit then average crater lifetime is:

$$\boldsymbol{\tau = 1/\lambda \text{ and } dN_{destr}/dt = -\lambda N \text{ or } dN_{destr}/dt = -N/\tau.}$$

If we assume also that in the adjacent areas with no or rare eolian landforms crater population is the production one and the rate of crater formation is the same as in the area with abundant eolian landforms then we can write the following system of equations:

$$\left\{\begin{array}{l} \mathbf{dN_{eol}/dt = dN_{form}/dt + dN_{destr}/dt} \\ \mathbf{dN_{adj}/dt = dN_{form}/dt.} \end{array}\right.$$

For the case when all the considered terrains at the initial moment of their formation had no impact craters ($\mathbf{N_0 = 0}$) a solution of this system is:

$$\mathbf{N_{eol}/N_{adj} = \tau/t\ (1 - e^{-t/\tau}).}$$

In this expression $\mathbf{N_{eol}}$ and $\mathbf{N_{adj}}$ are determined through crater counts on the images. $\mathbf{N_{adj}}$ is assumed to represent the production population so using calibration curve of [6,7] the crater formation rate $\mathbf{dN_{form}/dt}$ can be determined and then the surface age **t** can be estimated.

Observations. Crater counts in eight areas of Mars with abundant eolian landforms as well as in the adjacent areas with no or rare obvious eolian landforms were made using high-resolution Viking images [4, 5, 8]. Depending on image resolution the minimal diameter of craters used for counts varied from 50 to 200 m. Based on the count results cumulative curves of crater densities normalized on 10^6 km^2 were produced and used for the surface age estimation following [6,7]. In this study we reduced all crater density values to the crater diameter D = 200 m ($N_{>200}$) so our estimations of the crater lifetime (τ) are for craters of this size (see table).

Site	Landforms	N_{eol}	N_{adj}	t_{adj}, my	t_{eol}, my	τ_{200m}, my
Vastitas Borealis 2	*Large barchans*	1300	40000	3,830		**83**
Tempe Fossae	*Transverse dunes*	53600	238400	3,550	1,480	**539**
Elysium Planitia 2	*Transverse dunes*	97600	1266600	3,740	650	**192**
Acheron Fossae 2	*Barchanoid ridges*	19000	91300	1,120		**157**
Acheron Fossae 1	*Transverse dunes*	5000	35500	720		**68**
Acheron Fossae 2	*Transverse dunes*	8100	91300	1,120		**66**
Acheron Fossae 2	*Plains of eolian accumulation*	32000	91300	1,120		**281**
Elysium Planitia 1	*Yardangs*	6100	40000	3,430		**349**

Conclusion. Most estimated values of average lifetime of craters of 200 m in diameter observed on the studied eolian landforms of Mars are estimated to be within 100 to 200 my (The only “anomalous” value 539 my was found for Tempe Fossae where dunes are only few tens of meters wide and probably formed on thin eolian deposits within grabens). On the Moon average lifetime of craters of the same size observed in lunar maria was estimated to be about 700 my [1]. Shorter crater lifetime of martian craters on eolian landforms comparing with lunar craters looks reasonable because Mars surface shows evidence of recent eolian activity [10] and thus is obviously less favourable for preservation of craters and majority of other landforms comparing to lunar environment.

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